Title: Effects of regular away travel on training loads, recovery and injury rates in professional Australian soccer players.

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ABSTRACT

Background/Aim To examine the effect of match location (home vs. away) and competition phase (early vs. late) on training loads (TL), player wellness and injury around competitive soccer (football) matches.

Methods Eighteen male professional football players representing a team competing in the highest national competition in Australia participated in the present study. TL, player wellness and injury incidence, rate, severity and type, together with the activity at the time of injury was recorded on the day prior to, the day of and for four days following each of the 27 matches of the 2012/2013 season. This included 14 home and 13 away matches, further subdivided based on the mid-point of the season into early (1-13) and late competition (14-27) phases.

Results Whilst TL were significantly greater on day 3 at home compared to away during the early competition phase (P=0.03), no other significant effects of match location were identified (P>0.05). Total TL and mean wellness over the six days surrounding matches, and TL on day 3 were significantly reduced during the late compared to the early competition phase at home and away (P<0.05). Though not significant (P>0.05), training missed due to injury was 60 and 50 % greater during the late compared to the early competition phase at home and away, respectively.

Conclusions No significant interactions between match location and competition phase were evident during the late competition phase, which suggests away travel had negligible accumulative effects on the reduction in player wellness in the latter half of the season.

INTRODUCTION

Frequent short-haul air travel to and from away matches is a necessity for soccer (football) teams during the season [1]. Despite these travel demands, few studies detail acute travel effects on player wellness [2 3]. Whilst short-haul air travel may temporarily augment perceptual fatigue [3], negligible effects on physiological and performance responses are reported [2 3]. It has been proposed that frequent travel during the season may result in the accumulation of these minor acute effects [4], though as yet there is no evidence to support this hypothesis. Since travel is often required the day following away matches, subsequent training loads (TL) and recovery may be disrupted, reducing player wellness and increasing injury risk [5]. Given the proposed accumulation of travel related fatigue [4], these effects may be augmented following away matches in the latter half of the season. However to date, no studies have investigated the effects of frequent travel during a season on TL, recovery and injury in football.

Effects of short-haul air travel (<XXh) on performance, physiological and perceptual responses are equivocal [2 3]. Whilst greater perceived fatigue, worse mood states and reduced subjective sleep quality were identified following short-haul air travel in

professional athletes, no effects on strength and power or objective sleep quantity were reported [2 3]. The magnitude of travel completed by professional teams during a season can be substantial. For example, during a 27 week season, football teams in Australia are required to travel up to 3500 km by air, 26 times. Consequently, acute travel effects may be exacerbated in the late compared to the early competition phase, potentially resulting in reduced player wellness. However, the longitudinal effects of travel throughout a season on player recovery and wellness in football are unknown.

In-season, precise control of TL is required to maintain training adaptations achieved during pre-season and minimize the risk of non-functional overreaching and musculoskeletal injuries [6-8]. However, periodization of TL is often complicated by competition and travel schedules, along with the limited time between matches [9]. As a result of travel the day after an away match, the time lost, disruption of normal routines, and acute fatigue may hinder the recovery process. Therefore, compared to after a home match, the prescription of TL in the days leading into subsequent competition may be altered, and in conjunction with impeded recovery, could reduce player wellness and increase injury risk [5]. Moreover, repeated travel throughout the season may augment these disruptions and thus, increase injury risk in the late compared to the early competition phase. However, longitudinal effects of travel throughout a season on injury incidence in football are yet to be reported.

Therefore, the purpose of the present study was to examine the effects of match location (home vs. away) and competition phase (early vs. late) on TL, player wellness and injury prior to and following competitive football matches.

METHODS

Participants

Eighteen male professional Australian football players representing a team located in Sydney, Australia, competing in the highest national competition (A-League), participated in the present study; mean (95 % confidence intervals, CI); age 26.4 (24.7-28.1) y, height 168.8 (165.4-172.2) cm and body mass 72.11 (69.32-74.90) kg. At the time of data collection, players were participating in 3-5 sport-specific field-based training sessions, 1-2 recovery sessions, and 1 competitive match per week. Due to the location of opposing teams, players were required to undertake short-haul air travel for all but three away matches, where they travelled via road. All players volunteered to participate and prior to the commencement of the study, were informed of any associated risks and provided verbal and written informed consent. The study was approved by the institutional Human Research Ethics Committee.

Experimental design

Following familiarisation with all experimental measures and procedures, data was collected from players for 27 matches during the 2012/2013 A-League season. This included 14 home and 13 away matches against the same nine opposition teams, which were further subdivided, based on the mid-point of the season, into early (1-13) and late competition (14-27) phases. Though measures were obtained daily as part of the clubs normal training monitoring, only data collected on the day prior to (day -1), the day of (match day) and for four days following (day 1, 2, 3 and 4) each match, from players who's match duration was $\geq$ 60 min, were used for analyses. Thus, the total data points analysed was approximately 1,620 (10 players per match*27 matches*6 days). This specific time frame was

selected as travel occurred either one or two days prior to away matches, and the recovery timeline from competitive football matches is reported to be 72-96 h [10 11]. Consequently, effects of travel on the post-match recovery timeline and thus, player wellness leading into subsequent competition could be defined. Mean (95% CI) travel time and distance for air and road travel to away games was 2.3 (1.3-3.3) h and 1476 (621-2453) km, and 1.1 (0.4-1.8) h and 92 (22-162) km respectively. Direction of air travel was north and south across no time zones or east and west across two time zones.

Experimental procedures

Training loads (arbitrary units, AU) were calculated by multiplying each players training session or match duration (min) by their session rating of perceived exertion (sRPE) provided approximately 30 min following each training session or match [12]. A questionnaire based on previous recommendations [13] was used to assess players' fatigue, sleep quality, muscle soreness, stress levels and mood on a Likert scale from 1 to 5, in 0.5 point increments. Overall wellness was determined by summing the five scores [7]. Player wellness has been reported to be sensitive to changes in TL in an applied setting [7 14] and a useful indicator of athlete recovery and fatigue [7]. The questionnaire was completed approximately 60 min prior to each training session and match.

The definitions of injury used in the present study follow those recommended by the Injury Consensus Group of the FIFA Medical Assessment and Research Center [15] and are similar to those used in previous studies [11 16]. Specifically, an injury was defined as any physical complaint sustained by a player during a match or training that led to the player being unable to take full part in future

matches or training. All injuries were diagnosed by a full-time team physiotherapist, with the player considered to remain injured until the physiotherapist cleared them for participation in full training or matches. The time lost as a result of injury was calculated by the number of training sessions and matches missed. Injury exposure was calculated by multiplying the number of players by the session duration, and injury rate was determined by dividing the total number of injuries by the overall injury exposure, and expressed per 1000 training hours [8 11]. Injuries were also classified according to their type (non-contact or contact) and the activity at the time of injury (training or match) [8 11]. In addition, incidence of modified training, where a player completed a different session to the rest of the team, and no training, as a result of either excessive fatigue or injury was calculated. Absence arising from illness was not included in the study. Given the proposed association between reduced air quality in plane cabins and impaired immune function [17 18] this is acknowledged as a limitation of the present study.

Statistical Analysis

Unless substituted as a result of injury, data for each player was only included in analyses if match playing duration was ≥ 60 min. For all analyses, differences between match location (home vs. away), during the full season and early and late competition phases, and differences between competition phase (early vs. late) at home and away, were assessed separately. Data are presented as mean (95% CI), except for injury count data (Table 1). A generalized linear model, with poisson distribution and log link function, was used to examine differences in injury incidence, rate, severity and type, and the activity at the time of injury. Two-way analysis of variance (ANOVA) was used to determine the effects of match location and competition phase, and their interaction on total TL and mean

wellness over the six days surrounding each match. A linear mixed model was used to identify differences in TL and wellness on each individual day surrounding each match. Specifically, time and match location (home vs. away), and time and competition phase (early vs. late), and their interaction were fitted separately as fixed effects to determine whether there was a difference in the effect of match location or competition phase over time. In addition, player and match location (within player) or player and competition phase (within player) were fitted separately as random effects to account for the possible correlation within players, within location within players or within competition phase within players. Where a significant effect was observed ($P<0.05$), a post-hoc test (Tukey HSD) was used to determine differences between means. Analyses were performed using JMP statistical software (JMP Pro v 10.0, SAS, Cary, NC).

RESULTS

No significant differences existed between match location or competition phase for injury incidence, rate, severity, type or the activity at the time of injury ($P>0.05$; Table 1). Though not significantly different due to the low total number of injuries, training missed was 60 and 50 % greater during the late compared to the early competition phase at home ($P=0.09$) and away ($P=0.44$), respectively. Modified training was significantly greater following home compared to away matches by 77 and 60 % during the early competition phase ($P=0.04$) and full season ($P=0.02$), respectively.

Insert Table 1 here

Table 1 Effects of match location and competition phase on incidence, severity and type of injuries.

	Home			Away		
	Early Competition	Late Competition	**Season**	Early Competition	Late Competition	**Season**
Injury Incidence	3	4	**7**	2	3	**5**
Injury Rate	7.1	12.0	**9.2**	6.8	8.2	**7.6**
Training Missed	11	27	**38**	11	22	**33**
Matches Missed	4	6	**10**	3	4	**7**
Contact Injuries	0	2	**2**	0	1	**1**
Non-contact Injuries	3	2	**5**	2	2	**4**
Training Injuries	1	0	**1**	2	0	**2**
Match Injuries	2	4	**6**	0	3	**3**
Modified Training	13*	12	**25**[#]	3	7	**10**
No Training	6	5	**11**	1	7	**8**

[#]Significantly different to Away Season ($P<0.05$)

*Significantly different to Away Early Competition ($P<0.05$)

Total TL and mean wellness were significantly greater during the early compared to the late competition phase ($P<0.05$; Table 2). However, there was no significant effect of match location or interaction between match location and competition phase ($P>0.05$). No significant effects of match location or competition phase, or interaction was detected for match load (Table 2), together with no significant differences in match duration between home early competition (86 (84-88) min), home late competition (87 (85-89) min), away early competition (88 (86-90) min) and away late competition (87 (85-89) min) ($P>0.05$).

Insert Table 2 here

Table 2 Mean (95% CI) match physical load, total training load and mean wellness prior to, during and following each match at home and away and during the early competition and late competition phases.

	Match Load (AU)	**Total TL (AU)**	**Mean Wellness (AU)**
Home	722 (697, 747)	1767 (1571, 1963)	18.9 (18.7, 19.1)
Away	748 (721, 775)	1736 (1530, 1942)	18.7 (18.5, 18.9)
Early Competition	738 (711, 765)	1900 (1696, 2104)	19.0 (18.8, 19.2)
Late Competition	732 (707, 757)	1603 (1405, 1801)*	18.5 (18.3, 18.7)*
Home Early Competition	711 (676,746)	1983 (1705, 2261)	19.2 (18.8, 19.6)
Home Late Competition	733 (698, 768)	1549 (1271, 1827)	18.6 (18.2, 19.0)
Away Early Competition	765 (726, 804)	1815 (1513, 2117)	18.8 (18.4, 19.2)
Away Late Competition	731 (696, 766)	1657 (1379, 1935)	18.5 (18.1, 18.9)

*Significantly different to early competition ($P<0.05$).

Table 3 provides a general description of the training schedule, along with mean TL on each individual day surrounding home and away matches. During the early competition phase, TL tended to be greater on day 2 (P=0.09) and were significantly greater on day 3 (P=0.03) at home compared to away (Fig. 1C). Furthermore, during the early compared to the late competition phase, TL were significantly greater on day 3 at home (P<0.01; Fig 2A) and away (P=0.01; Fig 2C). Wellness was significantly reduced on day 1, 2, 3 and 4 compared to day -1 and match day. Furthermore, wellness was significantly greater on day 2 compared to day 1 over the full season and during the early and late competition phases at both home and away (P<0.05). On day 3 compared to day 2, wellness was significantly greater at home and away over the full season, at home during the early competition phase and away during the late competition phase (P<0.05).

****Insert Table 3 here****

Table 3 General description of training content and mean (95% CI) Training Load (TL) on the day prior to, the day of and four days following each match at home and away.

	Day -1	**Match Day**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
Home	Tactical	Match + Recovery	Day Off	Recovery (Pitch) + Yoga	Tactical	Conditioning + Gym
	147 (117-177)	721 (691-751)	0	90 (60-120)	465 (435-495)	373 (343-403)
Away	Tactical	Match	Recovery + Travel	Day Off	Tactical	Conditioning + Gym
	132 (102-162)	744 (714-774)	0	24 (0-48)	421 (391-451)	411 (381-441)

****Insert Figure 1 here****

****Insert Figure 2 here****

DISCUSSION

The present study examined the effects of match location and competition phase on TL, player wellness and injury prior to and following matches, in one professional Australian football team during a season of the A-League. Increased TL were evident following home compared to away matches during the early competition phase. Whilst this suggests travel following away matches may affect the weekly distribution of TL in the first half of the season, given no differences in wellness were identified following home compared to away matches, it is unlikely this was a result of travel impeding recovery. Moreover, reduced TL and wellness, and increased injury severity were evident in the late compared to the early competition phase. These results may imply that in the latter half of the season, players' recovery time following matches was slower and their ability to cope with the demands of training and competition were diminished. However, no differences were present at home compared to away during the late competition phase, which suggests away travel *per se* had a negligible impact on the reduction in player wellness in the latter half of the season.

Differences in the weekly distribution of TL were detected following home compared to away matches in the early competition phase. Conversely, no differences in weekly TL were reported between home and away matches in professional rugby league players [3]. However, as the recovery period from one match and preparation for subsequent competition are likely to affect

TL in the first and second half of the week, respectively, separating the effects of home and away matches on weekly TL is difficult. Assessing TL one day prior to, the day of and for four days following each match in the present study may have been a more effective way of isolating the acute effects of travel, though it is possible this was not fully achieved. As a result of losing a day to travel following away matches, differences in training schedules were evident on day 1 and 2 post-match at home compared to away. Time lost due to travel makes it difficult to prescribe the TL required to optimize training responses between matches, which may impact preparation for ensuing competition. Moreover, reduced TL on day 3 following both home and away matches, and reduced total TL over the six days surrounding each match were reported in the late compared to the early competition phase. These results may imply that in the latter half of the season players recovery time following matches was slower, which required TL to be adjusted accordingly. However, no differences in TL were evident between home and away matches during the late competition phase, which suggests the accumulative effects of travel had negligible impact on TL.

Similar to previous findings [5 7], wellness returned to baseline levels within four days following matches in the present study. This is also comparable to previous reports that recovery of performance, physiological and perceptual responses requires 72-96 h following competitive football matches [10]. Consequently, wellness may be a simple and effective method of monitoring post-match recovery in football. However, no differences in wellness were evident between home and away matches in the present study. In contrast, greater perceived fatigue, worse mood states and reduced subjective sleep quality have been identified one day prior to away matches in professional athletes [2 3]. Regardless, this is the first study to assess the effects

of match location on the recovery of wellness following competitive football matches and thus, further research is required to confirm these findings. Conversely, reduced mean wellness over the six days surrounding each match was evident in the late compared to the early competition phase. Together with the aforementioned reduction in TL, this implies that during the latter half of the season, players' recovery time following matches was slower, their ability to cope with training and competition demands was reduced and consequently, their preparedness for ensuing training and competition may have been diminished. Whilst this could indicate an accumulation of fatigue throughout the season, no differences in wellness were observed at home compared to away during the late competition phase, which suggests factors other than travel *per se* influenced player wellness in the latter half of the season. Moreover, as increased wellness has previously been reported over the course of an Australian Football League season [5], further research is required with larger data sets across multiple sports, teams and seasons to conclusively determine the longitudinal effects of travel on wellness.

In five out of the eight seasons since the beginning of the most recent version of the A-League, the team with the least injuries has finished top of the table [19]. Consequently, injury prevention is of upmost importance, with an understanding of the timing of peak injury incidence the fundamental first step in this process [20]. Increased training missed as a result of injury was evident in the late compared to the early competition phase for both home and away matches. This indicates greater injury severity in the late competition phase, which may be a result of the aforementioned reduction in player wellness, given its previous association with increased injury risk [5]. However, no differences in any injury measure were observed at home compared to away, which further suggests away travel had negligible effects on recovery and injury rates in

professional football players. In contrast to previous research that reports teams in European professional football can expect approximately 50 injuries per season [16], only 13 injuries were reported during the season in the present study. This is likely due to the greater number of games played per week in Europe compared to Australia, and therefore, research is warranted into the longitudinal effects of travel on injury risk, when more than one game is played per week.

In conclusion, acute effects of travel on the distribution of TL were observed following matches in the early competition phase. However, no other differences between home and away matches were detected for TL, player wellness or injury. Instead, reduced TL and wellness, along with increased training missed due to injury were identified during the late compared to the early competition phase. These findings suggest recovery time following matches was prolonged and thus, preparedness for ensuing training and competition may have been diminished in the latter half of the season. Whilst this may indicate an accumulation of travel-related fatigue throughout the season, results from the present study imply that away travel had negligible effects on the reduction in player wellness observed during the latter half of the season. However, as the present study only involved players from one team, it should be noted that the findings may only be a reflection of this particular team and their associated travel demands. Indeed, there are teams within Australian domestic competitions with greater travel demands ie. Western Australia or New Zealand for the present competition [1]. Therefore, further research involving larger data sets from multiple teams with a range of travel demands is required.

WHAT ARE THE NEW FINDINGS?

- Players' recovery time following matches was prolonged and their ability to cope with training and competition demands was reduced in the late compared to the early competition phase.
- Players missed more training sessions due to injury in the late compared to the early competition phase.
- The reduction in player wellness in the latter half of the season is due to factors other than travel *per se*.

HOW MIGHT IT IMPACT ON CLINICAL PRACTICE IN THE NEAR FUTURE?

- Increased emphasis should be placed on the use of adequate and appropriate recovery interventions following matches in the latter half of the season.

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COMPETING INTERESTS

The authors report no competing interests.

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